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D scripti n

This invention relates to a suspension for a pair of wheels for a vehicle, including a leaf spring extending transversely of the vehicle and supported relative to the vehicle structure at two positions spaced from one another between the ends of the spring, end portions of the spring engaging respective wheel supporting members. For example, the spring end portions may be connected directly to wheel supporting members by suitable swivel joints, or may act on wishbones or other members or arrangements of members which in turn are connected to wheel supporting members. The invention has been developed in relation to the suspension for the front wheels of a motor vehicle such as a passenger car, but it will be appreciated that it is applicable generally where similar problems, as described hereafter, arise, possibly for the rear wheels of a motor car or for the wheels of trailers or semi-trailers.

An example of a vehicle suspension including a leaf spring disposed transversely of the vehicle as above set forth is disclosed in published International Patent Application WO83/01758. In that suspension the spring, which is of composite, fibre reinforced plastics material, is of constant cross-sectional shape between its positions of mounting to the vehicle structure. Outboard of such positions, towards its ends, the spring is of decreasing width in plan view and increasing thickness, maintaining a constant cross-sectional area. Such outboard portions act as relatively rigid suspension links (of the type generally known as wishbones) in use and eliminate the need for separate links. Springing is provided by deflection of the portion of the spring between its mountings to the vehicle structure. Each wheel carrier is also connected to the vehicle structure by a telescopic damper strut.

When such a suspension is used for the front wheels of a motor car, particularly one with front wheel drive, the spring may need to pass beneath the engine and/or gearbox of the vehicle. Typically the engine and/or gearbox has a portion which extends fairly close to the ground on which the vehicle stands, and may even be the part of the vehicle having the least ground clearance. If then the transverse spring has to be mounted beneath such part, the overall ground clearance of the vehicle can be reduced to an unacceptable level. Further, sufficient space has to be left between the spring and engine/gearbox to allow for bending of the spring in use, further reducing ground clearance. These problems exist for any suspension utilising a transverse leaf spring, whether of the type above described or one in which wishbones or lik links are employed.

EP-A-083182 discloses a rear wheel suspension for a motor vehicle, including a transversely extending leaf spring which is connected to the vehicle chassis at two positions between its ends, the ends of the spring bearing on spring seats which are connected between front and rear transverse control arms at each side of the vehicle. In plan view the spring is straight, and in front elevation the spring is curved with its central portion extending upwardly relative to its ends. For a rear suspension, such a spring configuration causes no difficulties since there are no transmission components to be accommodated, nor do the suspended wheels have to be steered.

US-A-1573583 discloses a motor vehicle suspension, in which a transverse leaf spring supporting a vehicle axle is supplemented by a further leaf spring disposed below the axle. The further leaf spring has its centre portion curved to follow the profile of the differential, while the main leaf spring is disposed a considerable distance above the axle to allow for movement of the latter. Such spring arrangements significantly reduce the space available for the accommodation of other vehicle components.

It is the object of the present invention to overcome or mitigate the above described ground clearance problem.

According to the invention, there is provided a suspension for a pair of wheels of a vehicle comprising a spring in the form of an elongate leaf extending transversely of the vehicle and supported relative to the vehicle structure, for pivotal movement about axes extending generally longitudinally of the vehicle, at two spaced positions between the ends of the spring to provide a central portion of the spring and two end portions thereof, said end portions of the spring engaging respective wheel supporting members, characterised in that the said end portions of the spring are inclined to said central portion thereof, as viewed in plan.

In a suspension according to the invention, the central portion of the spring does not lie directly between the wheels, and hence the space directly between the wheels is available for the disposition of an engine, transmission or other vehicle part.

When the end portions of the spring are inclined to the central portion thereof, the forces imposed on the spring comprise primarily bending in the central portion of the spring, and bending and twisting in the end portions thereof. When the spring is of composite, fibre reinforced plastics, material, a suitable shape and disposition of fibres can be attained to withstand such forces.

The end portions of the spring may be generally straight, or may be curved, and such spring configurations are described hereafter.

The free ends or end portions of the spring may bear on pivoted arms or arm assemblies of

the type generally known as wishbones, which are connected to hub assemblies which may be swivel hubs if the wheels are steerable. However, it would be possible for inclined end portions of the spring to be connected directly to wheel supporting members or swivel hub assemblies so that the end portions of the spring, in effect, also act as wishbones as disclosed in WO83/01758 aforesaid.

The invention will now be described by way of example with reference to the accompanying drawings, of which:-

Figure 1 is a diagrammatic perspective view of part of a suspension according to the invention;

Figures 2 and 3 are, respectively, plan and elevational views of the suspension parts of Figure 1;

Figures 4 and 5 are plan views of further embodiments of spring for use in the suspension of Figures 1 to 3;

Figure 6 is a diagrammatic perspective view of a practical embodiment of suspension according to the principles of Figures 1 to 4.

Referring firstly to Figures 1, 2 and 3 of the drawings, there is illustrated part of a suspension for the front, steerable, wheels of a motor vehicle. It comprises a spring 30 which extends transversely of the vehicle, and two wishbones 31, 32 which are pivotally connected to the structure, not shown, of the vehicle. The pivotal axes of the wishbones are indicated at 33, 34 and they extend generally longitudinally of the vehicle. The outboard ends 36, 37 of the wishbones would be connected by swivel joints to hub assemblies, not shown, to provide for steering of wheels 38, 39 of the vehicle, the hub assemblies further being supported relative to the vehicle structure by further wishbones or damper struts.

The spring 30 comprises a central portion 40 which extends transversely of the vehicle, perpendicular to the centre line 35 of the vehicle, and two end portions 41, 42 which are inclined to the centre portion 40, extending outwardly and forwardly therefrom as viewed in plan. The free ends 43, 44 of the spring engage the wishbones 31, 32, respectively. The spring is supported relative to the vehicle structure by two mountings indicated generally at 45, 46, to provide for limited pivotal movement of the spring relative to the vehicle structure about two axes 47, 48 parallel to and spaced symmetrically from the centre line 35. In known manner, such a mounting of the spring resists roll of the vehicle as well as providing vertical springing thereof.

The spring 30 is made of composite, fibre-reinforced plastics, material. In this example, its centre portion 40 is of constant cross-sectional shape between the mountings 45, 46, whil the end portions 41, 42 thereof are tapered, becoming narrower in plan view and thicker in elevation towards the free ends of the spring. Such a shape of spring may be made of composite material by, for example, a pulforming technique, the cross-sectional area of the spring being constant throughout its length. The tapering configuration of the spring end portions is particularly advantageous in that it provides an increased clearance for steering of wheels 38, 39, this being particularly apparent for wheel 38 in Figure 2 of the drawings.

Referring now to Figure 4 of the drawings, there is shown a further embodiment of spring according to the invention, again comprising a central portion 50 and end portions 51, 52. End portions 51, 52 are inclined to the centre portion 50 but are of curved form instead of being straight. The cross-sectional shape of the spring centre portion is shown in the section X-X inset to Figure 4, and the end portion 51, 52 may be of the same cross-sectional shape or may vary, e.g. as in the embodiment above described.

Referring now to Figure 5, there is shown a spring with a centre portion 60 and end portions 61, 62. The end portions are straight and inclined to the centre portion of the spring, being connected thereto by curved transition portions 63, 64. The cross-sectional shape of the spring is constant throughout its length, as shown at Y-Y inset to Figure 5.

It is contemplated that springs of the shape shown in Figures 4 or 5 may be manufactured by laying-up a web of fibres which includes fibres extending in different directions. Thus there may be achieved a spring wherein the end portions thereof contain fibres which extend at an inclination to the general length of the end portions. This results in the end portions being sufficiently strong to resist twisting, which arises therein as a consequence of their inclination to the centre portion of the spring.

It is contemplated that all the embodiments of spring above described may be mounted relative to the vehicle structure at positions at or adjacent the transition between the central and end portions of the springs. The mountings provide for limited pivotal movement of the springs about axes extending generally longitudinally of the vehicle, but such axes need not be parallel to the centre line of the vehicle. By changing the orientation of such pivotal axes, changes in the effective stiffness of the springs may be achieved.

Referring now to Figure 6 of the drawings, there is shown, in perspective view and partially broken away for clarity, a practical embodiment of suspension incorporating a spring somewhat as shown in Figure 4 of the drawings.

The suspension comprises a sub-frame 80 extending transvers ly of the vehicle, fabricated by

welding together of metal pressings so that it is of hollow form. One end of the sub-frame 80 is illustrated with part of it broken away to show the interior thereof, and at the other end is illustrated a formation 81 for mounting the sub-frame to a vehicle structure. At one end of the sub-frame 80 there is pivotally mounted, by spaced pivot bush assemblies 82, 83, a suspension arm 84, and at the opposite end of the sub-frame there is similarly pivotably mounted a suspension arm 85. The suspension arms are able to pivot about axes extending generally fore and aft of the vehicle. The suspension arm 85 is shown, e.g. attached, by a swivel ball joint 86, to a wheel carrier member 87 which is further attached by a clamp 88 to the outer member of a telescopic damper strut 89 whose inner member, 90, has a mounting 91 for connection to an appropriately disposed part of the vehicle structure. The wheel carrier member 87 is thus able to undergo steering swivelling movement as well as vertical movement relative to the structure of the vehicle.

Also shown in association with wheel carrier member 87 is a wheel 92 carried by suitable bearings, a drive shaft 93 by which the wheel is to be driven through a suitable constant velocity ratio universal joint, and a steering arm 94 connected by a swivel joint to a steering link 95.

Within the sub-frame 80 there is disposed a spring whose configuration is somewhat like that above described with reference to Figure 4. The spring is supported within the sub-frame by two mounting assemblies, one of which is indicated at 101, such mounting assemblies being disposed at the ends of the straight transversely extending central portion (100) of the spring and each providing for limited pivotal movement of the spring about a respective axis extending fore and aft of the vehicle. For example, the mounting assembly may include elements between which the spring is clamped, typically with the interposition of an elastomeric element or elements, which elements are themselves pivotable by virtue of being held in a support such as an elastomeric bush. The curved end portion (102) at the fully visible end of the spring extends into the suspension arm 84 which is of hollow configuration, and the end of the spring b ars downwardly on a part of the suspension arm at 103 where a suitable abutment structure would be provided. In the drawing, the opposite curved end (104) of the spring is visible where it enters the suspension arm 85.

As for the theoretical embodiments of the invention above described, that of Figure 6 leaves a substantially clear space directly betw en the wheels of the pair, so that such space can be occupied by, e.g. an engine or transmission unit of the vehicle. The main part of the subframe 80 containing the central portion 100 of the spring is disposed somewhat to the front or rear of the wheel centres, where in many vehicles it may be accommodated more readily.

Claims

1. A suspension for a pair of wheels of a vehicle comprising a spring in the form of an elongate leaf extending transversely of the vehicle and supported relative to the vehicle structure, for pivotal movement about axes extending generally longitudinally of the vehicle, at two spaced positions (45, 46; 101, -) between the ends of the spring to provide a central portion (40; 50; 60; 100) of the spring and two end portions (41, 42; 51, 52; 61, 62; 102, 104) thereof, said end portions of the spring engaging respective wheel supporting members (31, 32; 84, 85), characterised in that the said end portions (41, 42; 51, 52; 61, 62; 102, 104) of the spring are inclined to said central portion (40; 50; 60; 100) thereof, as viewed in plan.

2. A suspension according to Claim 1 further characterised in that the spring is made of composite, fibre reinforced plastics, material.

3. A suspension according to Claim 1 or Claim 2 further characterised in that said end portions of the spring bear on pivoted arm members (31, 32; 84, 85) which are connected to wheel carrier members.

4. A suspension according to Claim 3 further characterised by a sub-frame (80) to which said arm members are pivotally connected and further providing said two spaced supports for the spring.

Revendications

1. Suspension pour une paire de roues d'un véhicule comprenant un ressort sous la forme d'une longue lame s'étendant dans le sens transversal du véhicule et supportée par rapport à la structure du véhicule en vue d'un pivotement autour d'axes s'étendant d'une façon générale dans le sens longitudinal du véhicule, en deux endroits espacés (45, 46 ; 101) entre les extrémités du ressort, de manière à présenter une partie centrale (40 ; 50 ; 60 ; 100) de ressort et deux parties d'extrémité (41, 42 ; 51, 52 ; 61, 62 ; 102, 104) de ressort, lesdites parties d'extrémité du ressort étant en prise avec les éléments de support de roues respectifs (31, 32 ; 84, 85), caractérisée en ce que les parties d' xtrémité (41, 42 ; 51, 52 ;

61, 62 ; 102, 104) du ressort sont inclinées par rapport à la partie centrale (40 ; 50 ; 60 ; 100) de ce dernier, vu en plan.

2. Suspension selon la revendication 1, caractérisée en outre en ce que le ressort est formé d'une matière plastique composite renforcée par des fibres.

3. Suspension selon la revendication 1, ou 2, caractérisée en outre en ce que les parties d'extrémité du ressort portent sur des bras pivotants (31, 32 ; 84, 85) qui sont reliés à des éléments de support de roue.

4. Suspension selon la revendication 3, caractérisée en outre par un berceau ou faux-châssis (80) sur lequel lesdits bras sont articulés et qui constituent en outre les deux supports espacés pour le ressort.

Patentansprüche

1. Aufhängung für ein Fahrzeugräderpaar, die eine Feder aufweist in Form eines quer zu dem Fahrzeug sich erstreckenden, gegenüber der Fahrzeugkarosserie gehaltenen länglichen Blattes, das eine Schwenkbewegung um im wesentlichen in Längsrichtung des Fahrzeugs verlaufende Achsen ausführen kann und zwar in zwei in einem Abstand voneinander angeordneten Stellungen (45, 45; 101, -) zwischen den Federenden, wodurch ein Federmittelabschnitt (40; 50; 60; 100) und zwei Federendabschnitte (41, 42; 51, 52; 61, 62; 102, 104) geschaffen werden, wobei die genannten Federendabschnitte in die entsprechenden Radhaltekörper (31, 32; 84, 85) eingreifen, dadurch gekennzeichnet, daß in einer Draufsicht die Federendabschnitte (41, 42; 51, 52; 61, 62, 102, 104) gegenüber dem Federmittelabschnitt (40; 50; 60; 100) geneigt sind.

2. Aufhängung nach Anspruch 1,
dadurch gekennzeichnet,
daß die Feder aus einem faserverstärkten Verbundkunststoff besteht.

3. Aufhängung nach Anspruch 1 oder 2,
dadurch gekennzeichnet,
daß die Federendabschnitte auf Schwenkarmelementen (31, 32; 84, 85) gelagert sind, die mit Radtragkörpern verbunden sind.

4. Aufhängung nach Anspruch 3,
dadurch g kennzeichnet,
daß ein Hilfsrahmen (80) vorgesehen ist, mit dem die genannten Armelement schwenkbar verbunden sind und der ferner die beiden genannten in einem Abstand voneinander angeordneten Haltemittel für die Feder schafft.

FIG 1

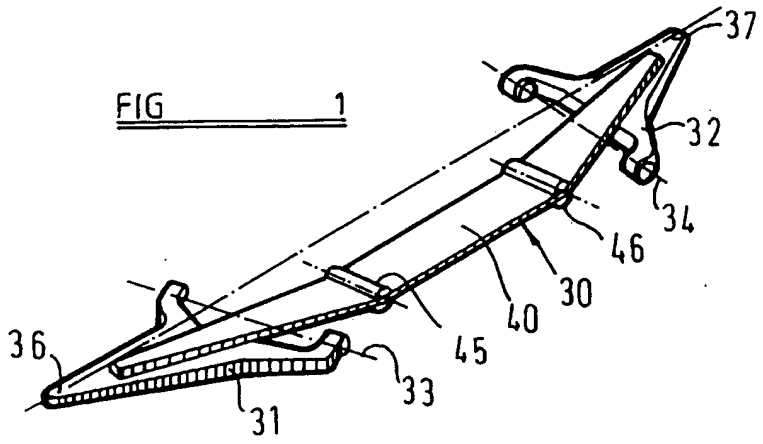

FIG 2

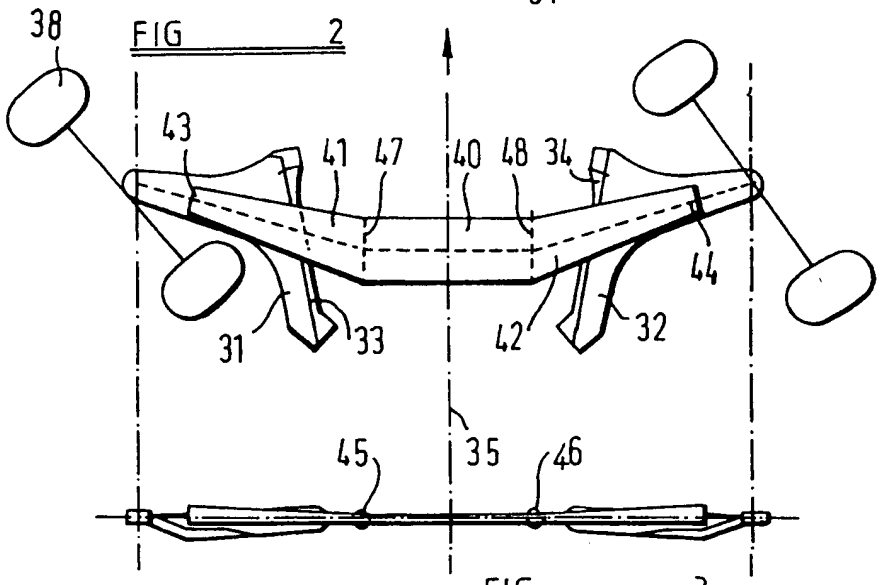

FIG 3

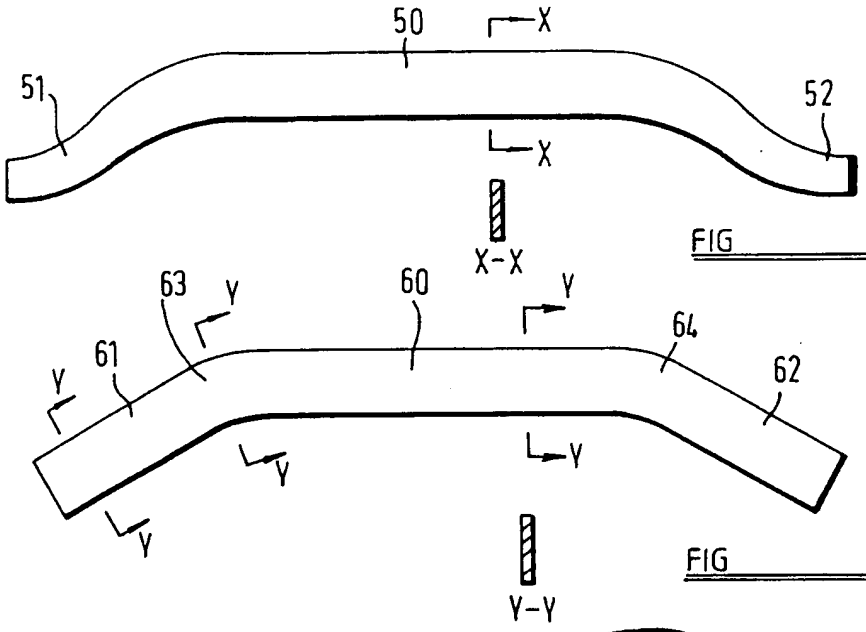

FIG 4

FIG 5

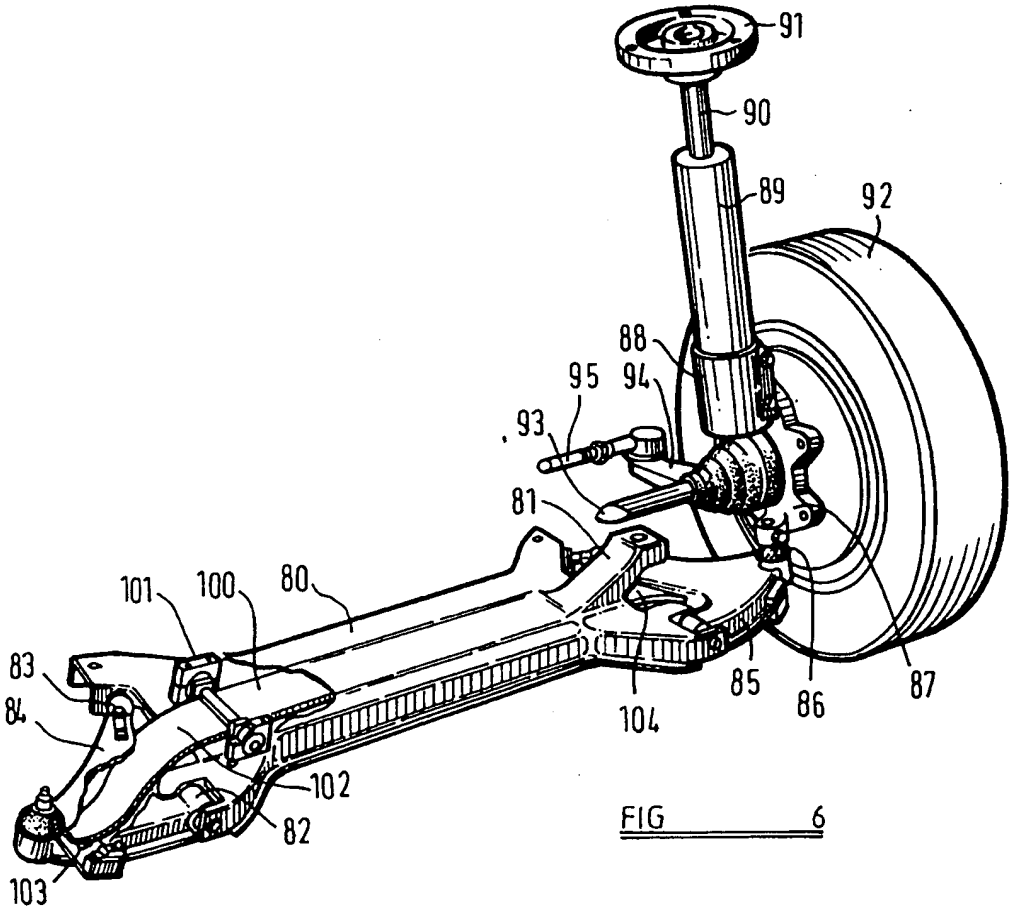

FIG 6